

A CLASSIFICATION OF THE GALL-MAKING COCCIDS OF THE GENUS
APIOMORPHA.

By WALTER W. FROGGATT.

(Thirty Text-figures.)

[Read 25th November, 1931.]

The Genus *Apiomorpha* was established by C. H. Rübsaamen in 1894 (Über Australische Zooecidien und deren Erzeuger, *Berlin. ent. Zeitschr.*, xxxix, pp. 17-42). He described and figured five species of the genus with other Australian gall-making insects. This genus now contains all the species previously included in the *Brachyscelis* described by H. L. Schrader, who first called attention to these wonderful gall makers (*Trans. Ent. Soc. N.S.W.*, 1862). He described five species which he collected in the neighbourhood of Sydney. My first contribution to the study of these remarkable creatures was in 1892 (Notes on the Family Brachyscelidae, with some account of their parasites, and descriptions of new species, These PROCEEDINGS, 1892, 353). In the following year, J. G. O. Tepper published a paper (*Trans. Roy. Soc. S. Aust.*) on the coccid galls in the collections of the Adelaide Museum in which he described some new species.

Between 1893 and 1898 I contributed four more papers on these insects to These PROCEEDINGS. In 1896, C. Fuller described some new species in the *Agricultural Gazette of N. S. Wales*. In the following year he described some new species in the *Journal of the Western Australian Bureau of Agriculture*. Later in the same year he amplified these descriptions (*Trans. Ent. Soc. London*) and described the gall of another species. No further species were added to the genus until 1921 when I described three (Descriptive Catalogue of the Coccidae of Australia, Part ii, *Dept. Agric. N.S.W.*, Science Bull. 18).

During the last few years, through the kindness of the Commissioners of Forestry for the different Australian States, their field officers and other country correspondents, I have been able to make a very extensive and interesting collection of gall-making coccids from all parts of Australia. During the last two years I have described five more new species.

In this contribution to the study of the Genus *Apiomorpha* I have mounted the skins of the adult female coccid and defined the species upon the arrangement of the hairs and spines on the dorsal surface of the derm, and the structure and form of the remarkable anal appendages peculiar to the members of this genus.

The female coccids have been boiled in ten per cent. caustic potash, the contents of the body washed out, treated with spirits of wine, chloroform, turpentine, and mounted on glass slips. The specimens do not require to be stained, and when treated in this manner give a clear outline of all the external structure.

Through the courtesy of the Council for Scientific and Industrial Research, who made me a grant for the purpose, I am enabled to illustrate this paper with outline drawings of thirty species made by Miss Ethel King.

These coccid galls are not produced in the same manner as the galls caused through the damage to the plant tissue by other insects. The galls developed from direct injury to the bark by the ovipositor of the wasp, fly, or other phytophagous insect, results from the intrusion of the egg and the subsequent infestation during the development of the larva, in the aborted tissue. In these gall-making coccids it is the free moving microscopic larvae which, burying their rostrum in the bark or leaf, cause the surrounding tissue to grow up and surround them. These larvae, born in the shelter of the mother gall chamber, cluster together in the base of the gall (like a mass of yellow dust) for some time before they crawl upward, and emerge through the small opening at the apex of the gall. They scatter all over the branches and foliage. Under a high power magnification one can see no outward difference in these hundreds of larvae, yet some produce male galls, and others produce female galls, each species with the same specific characters in the gall. If the male galls were always produced upon the foliage and the female galls on the branches one could understand the disparity of the size of these sex galls. This is not, however, the case because we often find large female galls formed on flower buds and, in other species, on the surface of the leaves. The male galls, also, though usually upon the leaves, are often found upon the branchlets side by side with the female galls, and in three species are formed in masses on the side of the female gall. Among the most remarkable forms are the compound galls, comprising three species, of which *Apiomorpha pharetrata* is the type. In this and the allied species, the oval female gall grows out on the surface of the leaf and when well developed, a fold of tissue grows out on one side, becoming many times larger than the supporting female gall. This consists of a mass of coalescing pits or tubes, each containing a larval male coccid, several hundred winged males often emerging from the one folded mass. As all the larvae emerge from the old parent gall at the same time, how do these males repress the gall-producing activities until the female gall is in a condition to support them? In the case of *Apiomorpha ovicola* and *A. helmsi*, large galls of solid woody tissue, how do they produce such a mass of matter through the tiny flower bud or seed capsule of a redgum tree, from which they are often developed? The development of these large galls is rapid; most of them complete their life cycle in the year. During their earlier stages of growth the apical orifice is closed, either by a folding over of the edges or a little plug, which contracts and falls out as the gall matures. Two species only have a distinct oval-elongate apical orifice: in one, *Apiomorpha pileata*, the young female galls are protected by a pointed cap of woody tissue which, with the growth of the gall, often expands into a long pointed tail several inches in length, drying up from the rounded base, and falling off like a paper envelope. The second species of this group, the largest insect gall in the world, *Apiomorpha duplex*, forms a large solid woody gall more than three inches in length, expanding into long curved tails or horns six inches or more in length. This has an even larger opening at the apex, but no protective covering.

In another, *Apiomorpha hillii*, there are two divisions; the gall chamber in the lower half with a closed summit containing the apical opening, with a solid rim round it; above the cavity is a conical lid, or elongated cap, which cracks off as the gall matures, but previously is the apical portion of the gall.

In most species the substance of the gall is hard and solid, with the inner surface of the coccid chamber smooth. In others, the gall consists of a double layer of woody tissue, as if the bark composed the outer layer and the sapwood the inner hard and woody portion. In *Apiomorpha variabilis* the gall is composed

of solid woody tissue surrounding a small coccid chamber, but there is a bell-shaped cap of softer tissue on the summit, with a rugged opening through it, above the apex of the solid gall. *Apiomorpha fletcheri* is a gregarious species; its infestation causes large irregular swellings on the branches. There are usually three or four coccids hidden in this galled wood, situated under a depression, covered by a scale of dried bark, the apical opening just level with the surface of the live bark. Remove the bark and soft tissue and you find a detachable funnel of hard wood resting on the rim of the coccid chamber, below which is simply an oval pit in the solid wood.

In *Apiomorpha macqueeni* the gall is a solid fig-shaped mass of wood, in the centre of which is a thin slender envelope of woody material readily detached from the woody gall surrounding it, in which the coccid is hidden.

The change from the larva to the first instar of the female coccid takes place very soon after the initial swelling out of the plant tissue, and before the gall is a quarter grown, the enclosed coccid at this stage exhibiting all the external appendages of the adult in a rudimentary form. The virgin female has a thin derm covered with white mealy secretion, and stands on her head with the tips of the anal appendages level with the top of the apical opening on the summit of the gall. She can move backwards and forwards in the gall chamber; when removed from the gall, and laid upon a glass slip, she has a habit of turning the abdominal segments upward and twitching her body. At this stage of development the contents of the body consist chiefly of clear watery fluid.

The full grown female coccid is tinted yellow or brown, the derm tough, and the external appendage chitinous with bands of yellow, reddish-brown, or black chitin, and the anal appendages hard and horny. They vary somewhat in form, but the typical ones are turbinate and are coated with floury secretion which also covers the walls of the gall chamber and the edges of the apical orifice in the gall. Both ventral and dorsal surfaces are clothed with scattered fine spiny hairs, with finer longer hairs fringing the anal segments in some species. Besides the hairs on the dorsal surface there are scattered bands, or regular transverse rows of lance-shaped, conical, or thorn-shaped spines, on the abdominal segments; in exceptional cases these extend on to the thoracic and cephalic region.

The cephalic and first and second thoracic segments coalesce to form an oval body; the third thoracic segment, round on the sides and across the basal margin, forms a distinct band which might be likened to the waist, and the tapering rounded anal segments to the tail. The cephalic forms a rounded fold with the first thoracic segment, in the centre of which are the aborted antennae, below which are the small fore legs, with the mouth in the centre between them. The two anterior spiracles are on either side above. The second thoracic segment is very broad, with a v-shaped cleft in the centre below the mouth forming a pit with a wrinkled area on either side bearing the second pair of legs, and a transverse fold below, deeply divided on the apical margin by the segmental division between it and the third thoracic segment. This bears the larger hind legs, and the posterior spiracles just above the base of the legs. There are seven abdominal segments, the first six well defined, but the seventh much reduced in size and coalescing with the base of the anal appendages, a pair of horny pointed lobes, which occupy the tip of the anal segment in some species; in others they occupy the dorsal half and the fringed anal ring is behind them on the ventral side; in others the anal ring is situated at the base of the anal appendages. The gravid

female is a sac of larvae which, as they are born, leave the moribund mother a wrinkled skin in the bottom of the gall chamber.

As previously noted, in a number of species the male galls outnumber the female galls by thousands; in one species in particular, the four-horned gall-maker, *Apiomorpha munita*, great masses of the tiny tubular galls, resembling a bunch of coral, may be on a branch with not more than fifty female galls. The delicate pink two-winged male has been described in my first paper (These PROCEEDINGS, vii, 1892, 356). They develop in the tubular galls with two long white filaments produced on the sides of the slender body, extending beyond the end of the gall chamber. The larvae, after emergence from the body of the mother, congregate at the bottom of the gall chamber and remain in a semi-dormant state for some time before they crawl upwards and escape through the apical orifice. They are to be found in the galls in September and October. They are pale yellow, flattened little creatures, oval in form, with a cleft in the cephalic margin, between the base of the seven annular jointed antennae. The anal segment is produced into two rounded lobes. The eyes are black, the legs long and slender, with the tarsal claws sharp and usually with a pair of digits. The whole body is fringed right round with fine sharp spines.

In the present paper I have briefly described the male and female galls, and given the range of the different species, and the specific name of the host eucalyptus. I am giving a group classification of all the species of the genus, based on the form and disposition of the hairs and spines on the dorsal surface, and the structure of the anal appendages. There are two species which I cannot place: *Apiomorpha Karschi*, described by Rübssaamen, probably a variety or abnormal specimen of *A. fletcheri* and *Apiomorpha cucurbita* described from the female galls only by Fuller.

Classification of species of *Apiomorpha* by the structure of the female galls and the arrangement of the hairs and spines on the dorsal surface, together with the form of the anal appendages.

- Group A.*—Galls solid, sessile, formed on the branchlets or stem; apical orifice an elongate-oval slit. Coccid with the anal appendages widely separated at the base, long, slender, broadest at base, with a tuft of long hairs at the tips . . . *duplex*; *pilata*.
- Group B.*—Gall variable in form, rugose at apex, with the apical orifice small, circular. Sessile on twigs or branchlets. Coccid with the anal segment very long and slender, anal appendages not coalesced with anal segment, long, slender, flattened, turning outward from the base, bifid at the tips *urnalis*; *macqueeni*; *umbellata*; *sloanei*.
- Group C.*—Galls formed on the leaves, slender or elongate-oval. The apical orifice small, circular. Coccid with anal segment without spines, conical. Anal appendages not coalescing with the anal segment, slender, sabre-shaped, with the bases occupying only the dorsal half of the anal segment, tips slightly bifid
 *pharetrata*; *thorntoni*; *rosaeformis*; *spinifer*; *fusiformis*.
- Group D.*—Galls oval, smooth or fluted, sessile, apical orifice small, circular. Normally produced upon the branchlets, but often growing out of the flower buds. Coccid with the dorsal surface covered with scattered thorn-shaped spines. Anal segment longer than broad, anal appendages coalescing with anal segment, which is broad at the base, round and rugose on the sides and with the anal appendages forms a lance-shaped tip, which is slightly bifid *ovicola*; *helmsi*; *withersi*; *floralis*.
- Group E.*—Galls consisting of oval pits in masses of galled wood upon the branches, with a detachable funnel-shaped cap perforated at the apex, which fits over the chamber below. Dorsal surface without any large spines, very chitinous, anal segment and anal appendages coalesced, broad at base, tapering to the tips *fletcheri*.
- Group F.*—Galls oval, sessile upon the branches, covered with fine curled filaments. Coccid with abdominal segments chitinous, fringed with fine spines, short anal segment, rounded at the base, coalesced with the short anal appendages which are broad at the base, with the tips peg-shaped and curving outward, and fringed with fine hairs, bifid at the tips *dipsaciformis*; *excupula*.

- Group G.*—Galls variable, usually sessile and broad at the base, sometimes slender and stalked. Apical orifice small, circular. Coccid with few or no large spines on the thoracic and first two abdominal segments. Anal segment longer than broad, truncated base; anal appendages broad at base, rugose, cylindrical, tapering to the tips which open out from the base into pointed tips; coalescing with anal segment *pedunculata*; *longmani*; *frenchi*; *conica*; *attenuata*.
- Group H.*—Galls sessile, rounded, slightly flattened or depressed on the apex, with small circular apical orifice. Growing on the branchlets. Coccid very lightly clothed with large spines. Anal segment and anal appendage forming an elongate triangular point, the sides serrate, with blunt or bifid tips *globosa*; *maliformis*; *strombylosa*; *variabilis*; *bauerleni*.
- Group I.*—Galls rather small, sessile, rounded at the base, with or without terminal appendages. Apical orifice small, circular. Coccid with the abdominal segments small, chitinous, fringed with fine hairs. Spines on dorsal surface scattered, usually some on the thoracic segments. Anal segment and anal appendages coalesced, broad and rounded at the base, curving out in the centre, with the tips small and bifid *munita*; *hilli*; *sessilis*; *minor*; *dumosa*; *rugosa*; *annulata*.

Group A.

APIOMORPHA DUPLEX Schrader. Text-figs. 30, 30a.

This large gall is found from Sydney to Newcastle and the Blue Mountains upon *Eucalyptus saligna*, *E. piperita*, *E. haemastoma*, *E. Camfieldi*, and *E. eugenioides*. Other records are given in These PROCEEDINGS, lv, 1930, 471.

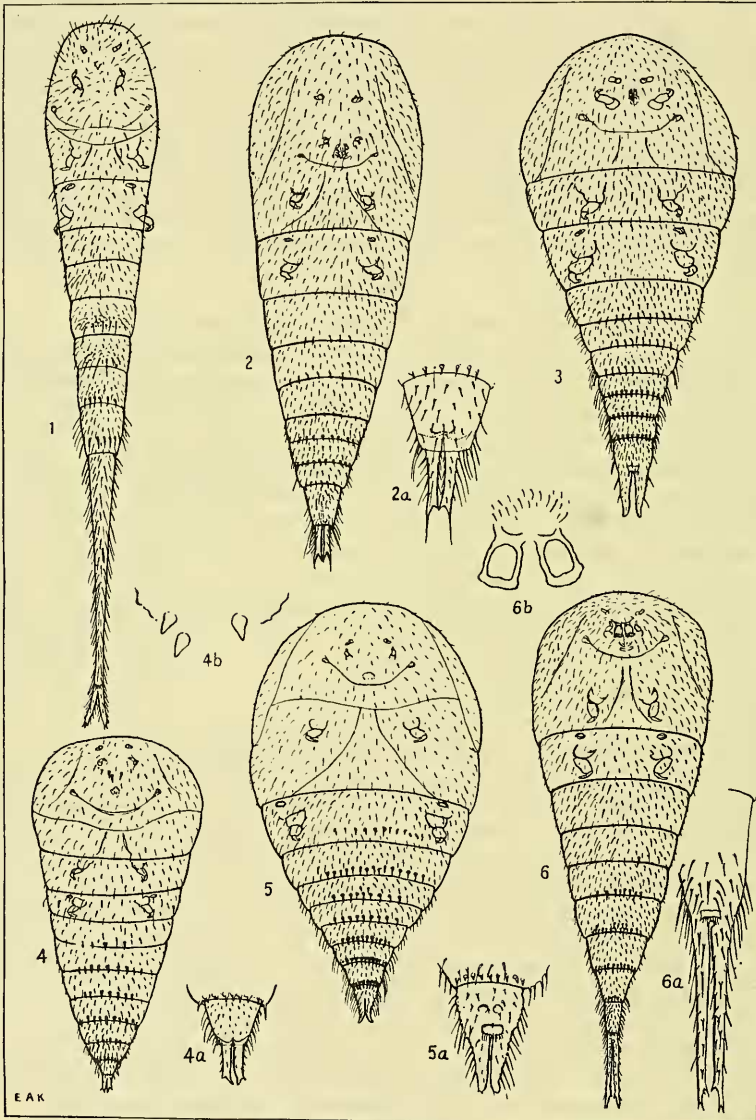
The female gall is sessile, growing out from the side of the branch, swelling out into a green four-sided, elongate, ridged mass of solid woody matter, 3 inches in length from the base to the apical orifice. The orifice forms a narrow slit between the two flattened curled leaf-like horns, often up to 7 or 8 inches in length, which project on either side of the solid basal portion. As the galls mature they turn brown and are much more noticeable among the surrounding green foliage. This remarkable gall has been figured several times. Schrader gave a drawing of it when he described the type. The late Mr. Grose (*Agric. Gaz. N.S.W.*, 1898) gave a life-size drawing which was reproduced in my "Australian Insects," 1907. Tillyard (*Insects of Australia and New Zealand*, 1926, Pl. 14) figures a very slender form.

♀. Coccid 1½ inches in length, broad in proportion, thickly covered with floury secretion which is also thickly coated over the walls of the gall chamber. Derm lightly clothed with some very small slender spines and annular pores on the cephalic and thoracic segments. Abdominal segments thickly covered with very long spiny hairs and more annular pores; the hairs form regular bands across the segments interspersed with lance-shaped spines; 1st and 2nd segments with small lance-shaped spines among the hairs, 3rd with larger lance-shaped spines forming an irregular band; 4th to 6th with similar spines arranged in a regular row across the lower portion; in the 4th and 5th segments the spines are grouped in two or four. Anal segment spineless, but lightly clothed with long spiny hairs; round on the sides, with the anal ring fringed with fine hairs in the centre, at the base of the anal appendages, which, coalescing with the anal segment, are broadest at the base, widely separated from each other; long and slender to the pointed tips, which are fringed and tufted with long hairs.

APIOMORPHA PILEATA Schrader. Text-figs. 11, 11a.

This distinctive gall is found in the vicinity of Sydney, chiefly upon the branchlets of stunted specimens of *Eucalyptus Sieberiana*. I have specimens upon *E. umbra*, Gosford, and on *E. acmenioides* from Glen Innes, Mr. T. W. Taylor. In

the herbarium of the Botanic Gardens there are specimens on *E. piperita*, Concord, Miss Walker; *E. Camfieldi*, Hornsby, Mr. W. F. Blakely; *E. robusta*, Hill Top, Mr. E. Cheel; *C. virgata*, Gosford, Mr. de Beuzeville; *E. acmenioides*, Uringa, Mr. F. A. Andrews; *E. sp.*, Port Macquarie, Forester Brown. The only specimens from out-

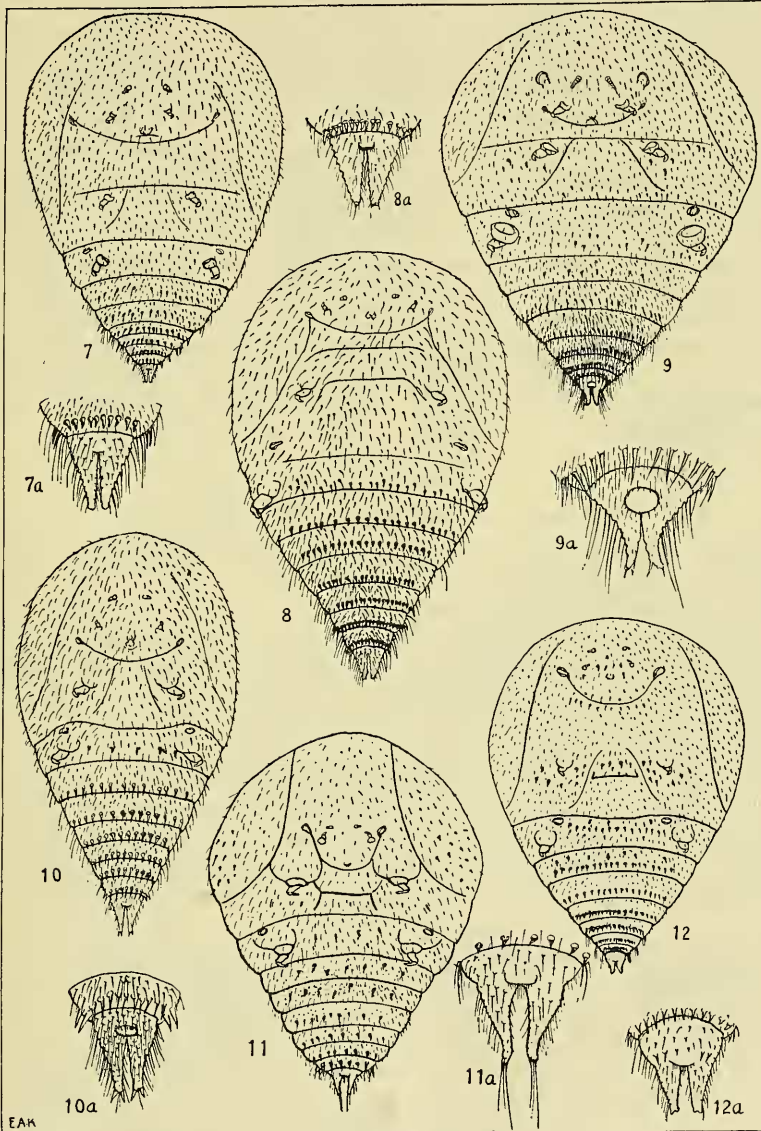


Text-figs. 1-6.

- 1.—*Apiomorpha macqueeni* Froggatt. 2.—*Apiomorpha fusiformis* Froggatt (2a, anal segment). 3.—*Apiomorpha longmani* Froggatt. 4.—*Apiomorpha spinifer* Froggatt (4a, anal segment; 4b, blunt spines on cephalic region). 5.—*Apiomorpha annulata* Froggatt (5a, anal segment). 6.—*Apiomorpha umbellata* Froggatt (6a, anal segment; 6b, bell-shaped appendages on cephalic region).

side the State are from the Dandenong Ranges, Victoria, collected by Mr. C. French, Jr.

The male and female galls are gregarious, often aborting the leaves and twigs of an infested tree. The male galls, scattered over the leaves, are cylindrical tubes with the apex dilated. The female galls have two distinct forms, but all



Text-figs. 7-12.

- 7, 7a.—*Apiomorpha dumosa* Froggatt. 8, 8a.—*Apiomorpha minor* Froggatt.
 9, 9a.—*Apiomorpha excupula* Fuller. 10, 10a.—*Apiomorpha globosa* Froggatt.
 11, 11a.—*Apiomorpha pileata* Schrader. 12, 12a.—*Apiomorpha dipsaciformis*
 Froggatt.

conform to the one type on each tree. They are sessile, green, and in the first type elongate-oval, rounded to the apex which is deeply truncate, with the sides forming two folds or lips with an elongate slit between them, instead of the circular apical orifice of most species. The second form is squat and oval, with the summit more deeply cut into on either side of the opening. In the early stages of their development the summit of each gall is covered with a tailed cap, often tapering out several inches in length; as the gall develops this cap dries and drops off the gall. Schrader figured these galls in his original description of the type. I give a drawing of the oval variety in my Descriptive Catalogue, Part ii, 1921, and Tillyard also figures them (*Insects of Aust. and N.Z.*, Pl. 14).

Female coccid three-fourths of an inch in length. Derm clothed with fine spiny hairs increasing in numbers and length to the tip of the abdominal segments. The whole surface covered with small annular pores, densest on the abdominal segments. A few scattered small lance-shaped spines across the centre of the thoracic segments; 1st and 2nd abdominal segments with scattered lance-shaped spines across the centre; 3rd to 6th banded with chitin and an irregular row of larger lance-shaped spines. Anal segment small with a dark chitinous band on each side coalescing with the base of the anal appendages which are separated from each other by the fringed anal ring; anal appendages peg-shaped, broad at the base, slender, irregularly rounded to the pointed tips which carry a tuft of three or four long hairs.

Group B.

APIOMORPHA URNALIS Tepper. Text-figs. 26, 26a.

The type specimen of this dainty jug-shaped gall was described from South Australia. We now know it as one of the inland species common upon various species of the dwarf gums of the Mallee scrubs.

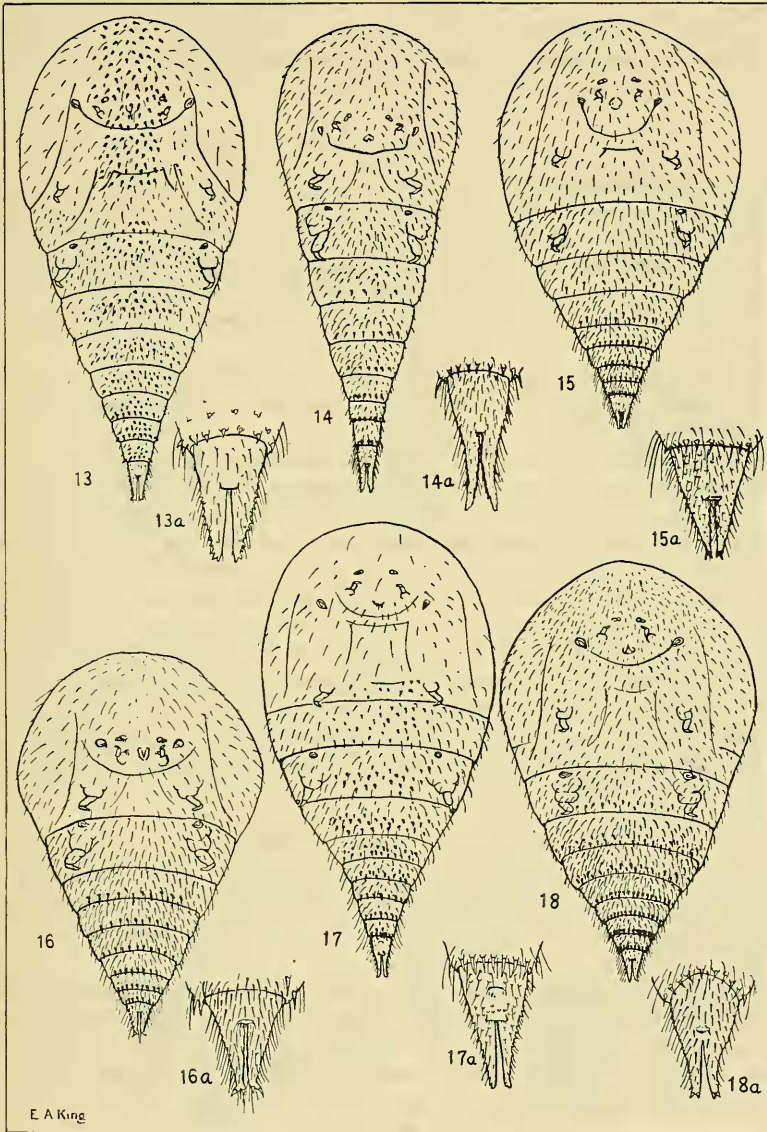
The range and list of eucalypts it infests I have recorded (These PROCEEDINGS, 1930), with a photograph showing the variations in the form of the female galls. The male galls are of the typical cylindrical form, and are scattered over the twigs and foliage among the female galls.

The female coccid is very slender, with the base narrow, round, and swelling out on the sides in a line with the second pair of legs, the first four abdominal segments with the outer margins uniform, with the 5th and 6th narrow and rounded, 7th spindle-shaped, tapering to the apex, longer than the 5th and 6th combined. Anal appendages not coalescing with the anal segment, dark reddish-brown, long and slender, open at the base, and curving outward, bifid at the slender tips.

Derm with a yellow chitinous patch in the centre of the cephalic fold covered with small slender lance-shaped spines of variable sizes, which are encircled by ten irregularly rounded dark-brown lobes, with three irregular shaped spined black lobes below, two above, and one below the second pair of legs. The thoracic segments clothed with scattered, very fine spiny hairs. The legs rather slender, dark brown with a short narrow bar of the same colour on each side of all the segments. The first three abdominal segments broadly banded with fine spiny hairs, and a few small stout spines in the centre; 4th to 6th with similar hairs and a regular band of small lance-shaped spines; 7th deep yellow, with very fine spiny hairs lightly scattered all over the surface and a few long slender spines in the centre.

APIOMORPHA MACQUEENI Froggatt. Text-fig. 1.

This species, which is apparently confined to the southern forest land of southern Queensland, has only been recorded upon the branchlets of the narrow-leaved ironbark, *Eucalyptus pilligaensis*.



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Text-figs. 13-18.

- 13.—*Apiomorpha ovicola* Schrader (13a, anal segment). 14.—*Apiomorpha pedunculata* Fuller (14a, anal segment). 15.—*Apiomorpha strombylosa* Tepper (15a, anal segment). 16.—*Apiomorpha variabilis* Froggatt (16a, anal segment). 17.—*Apiomorpha withersi*, n. sp. (17a, anal segment). 18.—*Apiomorpha maliformis* Fuller (18a, anal segment).

The female gall is very variable in form, and since it was described in These PROCEEDINGS in 1929, I have had a large series from Mr. Macqueen, some of which have a wonderful resemblance to a fig, others to a top; others are almost spindle-shaped, but all have the typical ragged apex.

The male galls which have also come to hand are of the normal type of small cylindrical tubes, scattered over the surface of the leaves. The extraordinary elongation of the anal segments, particularly the anal one, which is quite distinct from the slender flattened anal appendages, is well depicted in Miss King's drawing.

APIOMORPHA UMBELLATA Froggatt. Text-figs. 6, 6a, b.

The type specimens were collected by Mr. J. L. Boorman upon a Mallee gum, *Eucalyptus dumosa*, near Cobar, N.S.W. It has since been sent from Griffith, N.S.W., upon *E. oleosa*, by Mr. W. D. Campbell. Another unique specimen on the branch of a Mallee gum comes from Coolebah, N.S.W., where several galls of this species are growing side by side with other galls of *Apiomorpha conica*. Professor J. B. Cleland has lately sent it from Flinders Range, South Australia, upon *E. odorata*.

The female galls, usually in clusters upon a branchlet, are sessile, narrow at the base, cylindrical, swelling out to the truncate apex, which is rugose, the small apical orifice in the centre.

Female coccid very slender, the cephalic segment rounded, clouded with yellow in the centre, and covered with fine pointed spines, encircled by a band of dark brown lobes, three on either side and four below, besides which there are three black, irregularly spined lobes, two above and one between the second pair of legs. There is a pair of short brown bars on each segment; the thoracic ones clothed with fine spiny hairs and a few short small spines; 1st to 3rd abdominal segments clothed with fine spiny hairs and a few short spines; 4th and 5th with similar spiny hairs and a band of fine spines; 6th contracted and rounded on the sides with the short spines forming a band across the lower margin. The anal segment yellow, very long, slender, spindle-shaped, narrow to the apex, clothed and fringed with fine spiny hairs, not coalesced with the anal appendages which open from the base and are dark brown, very long, irregularly rounded, slender, rugose and bifid at the tips.

APIOMORPHA SLOANEI Froggatt.

The gall and adult coccid of this species are figured and described in These PROCEEDINGS, 1898. The type specimens were collected by Mr. T. G. Sloane on an unidentified eucalypt in the Wagga district, N.S.W. I have never seen any other specimens.

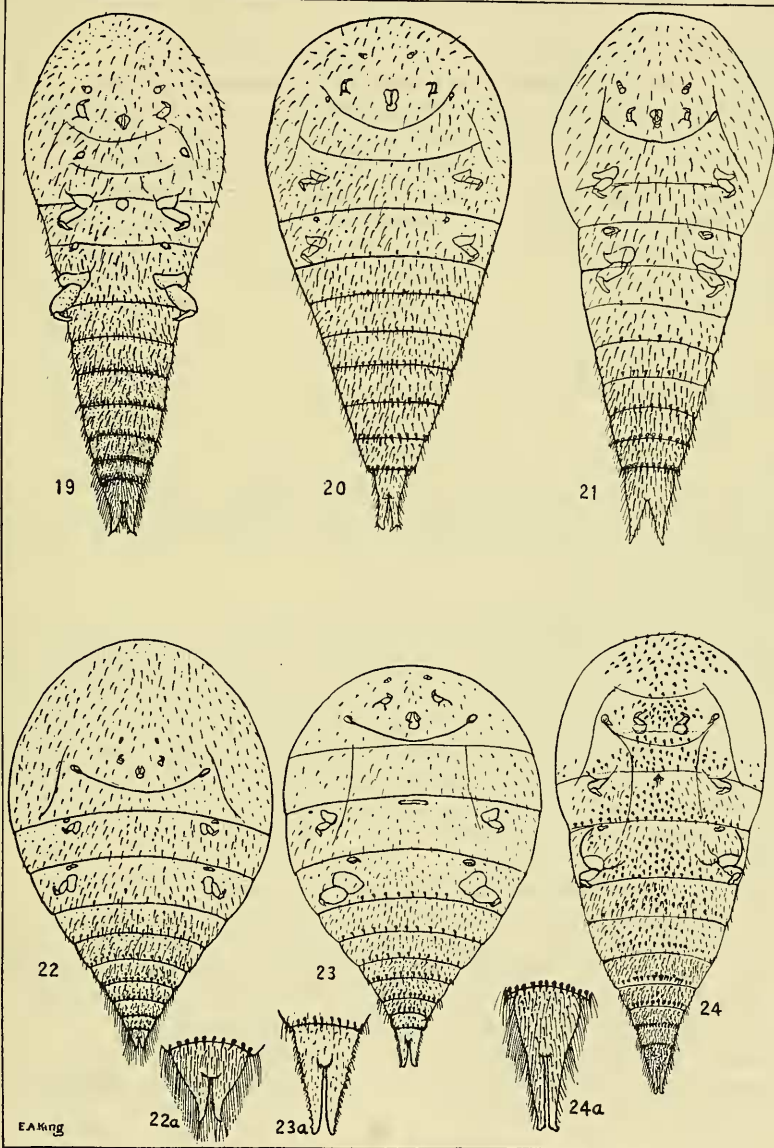
The elongate cylindrical galls have a general appearance similar to those of *Apiomorpha pedunculata*. The enclosed coccid, however, belongs to the group with the slender form, in which the anal segment is longer than the rest of the abdominal segments combined, not coalesced with the anal appendages which open from the base and are long and slender.

Group C.

APIOMORPHA PHARETRATA Schrader. Text-figs. 27, 27a.

This "cockscorb" gall was described and figured by Schrader in 1862 upon *Eucalyptus corymbosa* growing in the vicinity of Sydney, and is recorded upon

several other species. It has a wide range, a record of which is given in my paper in These PROCEEDINGS, 1930, where it is figured. There is another figure in my Descriptive Catalogue, Pt. ii (*Science Bulletin* 18, Department of Agriculture of N.S.W.).



Text-figs. 19-24.

19.—*Apiomorpha conica* Froggatt. 20.—*Apiomorpha thorntoni* Froggatt. 21.—*Apiomorpha attenuata* Froggatt. 22.—*Apiomorpha munita* Schrader (22a, anal segment). 23.—*Apiomorpha bäuerleni* Froggatt (23a, anal segment). 24.—*Apiomorpha helmsi* Fuller (24a, anal segment).

The female galls produced upon the leaves often springing from the midrib and aborting the foliage. The gall is oval, with the apex truncate. The male galls consist of a mass of coalesced tubes turned down and enfolded in a smooth rounded mass of tissue which springs out of the side of the female gall and is concave on the gall-tube side, and many times the size of the half-hidden female gall.

Female coccid turbinate, 10 mm. in length. Derm lightly clothed with fine spiny hairs, a slight chitinous fold between the second pair of legs. 1st and 2nd abdominal segments covered with longer spiny hairs and a few scattered small lance-shaped spines; 3rd to 5th with an open row of small lance-shaped spines across the centre, but not extending to the outer margins; 6th with a reddish chitinous band across the lower margin, fringed with lance-shaped spines. Anal segment cone-shaped, apical half reddish-brown, truncate on the ventral side which bears the anal ring fringed with hairs. Anal appendages reddish-brown, not coalescing with the dorsal surface of the anal segment, slender, pointed and curving outward.

APIOMORPHA THORNTONI Froggatt. Text-fig. 20.

This species is found upon the foliage of *Eucalyptus piperita* in the Newcastle district and in the vicinity of Sydney. I have it from Guyra, N.S.W., upon *E. macrorrhyncha*, Rev. E. N. McKie; and *E. amygdalina*, Dandenong Ranges, Victoria, Mr. C. French, Jr. The galls are compound and differ from those of *Apiomorpha pharetrata* in the female galls being smaller, ribbed on the sides, and the attached mass of male galls being much more irregular in form and wrinkled. A description of the immature female gall and coccid is given in my paper in These PROCEEDINGS, 1930.

Female coccid turbinate, tapering to apex. Length, 8 mm. Derm thin, with the cephalic and thoracic segments lightly clothed with fine spiny hairs, 1st and 2nd abdominal segments with an irregular band of fine lance-shaped spines interspersed with spiny hairs; 3rd to 6th with a regular row of lance-shaped spines along the lower margin, on the 6th a narrow chitinous band carries the spines. Anal segment conical, with the exception of the basal margin reddish-brown; in general structure like that of *Apiomorpha pharetrata*, but the anal appendage rugose on the ventral surface, and curving outward. Anal ring on the ventral side of the tip of the anal segment.

APIOMORPHA ROSAEFORMIS Froggatt.

This beautiful compound gall is a very rare species and in the three specimens examined the spindle-shaped female galls contained nothing but the remains of the female coccid. The type specimen came from Wingham, Manning River, N.S.W. Two other specimens were collected by Professor J. B. Cleland on a stringybark, *Eucalyptus capitata*, at Neutral Bay, near Sydney.

I figured the type specimen in These PROCEEDINGS, 1895, and in 1930 I gave a figure showing the slender female gall with its attached mass of pink-tinted disk of male galls.

APIOMORPHA SPINIFER Froggatt. Text-figs. 4, 4a, b.

This species was described in my paper in These PROCEEDINGS, 1930, from specimens upon an undetermined species of *Eucalyptus* from Stanthorpe, Queensland. These galls were very like those of *Apiomorpha fusiformis*, but more trun-

cate at the apex. Since this was described I have received a fine series of this species from Portland, N.S.W., from Archdeacon Haviland, also on an undetermined species of *Eucalyptus*.

The male galls appear to be rather short and squat, with the apex swollen out into a rounded lump deeply depressed in the centre, but are much aborted by chalcid parasites, which also have infested many of the adult females in the galls. The female galls are in threes and fours along the midrib of the leaf, 10 mm. in height and 4 mm. in diameter. They are very irregular in form and colour, varying from green to brown and often blackened with fumagine. The galls are narrow at the base, irregularly oval in form and not so slender as in the type specimens, but the apex is ringed in the same manner.

The female coccids have the cephalic spines very well defined, varying from two to four in number.

APIOMORPHA FUSIFORMIS Froggatt. Text-figs. 2, 2a.

This species was described in my paper in These PROCEEDINGS, 1930. It comes from Queensland, and the type is in the Queensland Museum. The anal ring is fringed with fine hairs, and occupies the ventral side of the anal segment.

Group D.

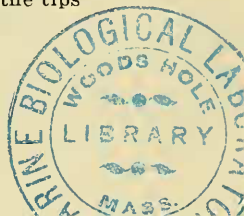
APIOMORPHA OVICOLA Schrader. Text-figs. 13, 13a.

This is an inland species found upon the branchlets and not uncommon on the flower buds of the red gum, *Eucalyptus rostrata*, and as this gum tree is found along the edges of all the inland rivers and water-courses in all parts of Australia, it probably has a very wide range. The type was described by Schrader from the vicinity of Sydney. I have specimens, usually solitary, upon *Eucalyptus microtheca*, Narrabri, Mr. Gordon Burrows; *E. siderophloia*, Gilgandra, Mr. G. Withers; *E. crebra*, Dubbo, W.W.F.; *E. fructorum*, Griffith, Mr. W. D. Campbell; *E. largiflorens*, Curra Curra, Mr. J. H. Maiden. From Queensland on *E. paniculata*, Mr. A. M. Rankin. From Victoria on *E. melliodora*, Stawell, Mr. C. Daley. From South Australia upon two mallee gums, *E. incrassata* and *E. gracilis*.

Male galls small, cylindrical, dilated at the apex, scattered over the leaves and branchlets.

Female galls broadly oval, green and smooth, walls solid, apex slightly depressed, with small circular apical orifice. When infested with phytophagous inquilines feeding in the tissue of the young galls, they often become aborted and vary in form. Tepper (*Trans. Roy. Soc. S. Australia*, 1893) described and figured two of these aborted forms under different names.

Female coccid slightly less than an inch in length. Derm thin and clear, slightly chitinous on the abdominal segments, and a narrow band between the legs. The whole surface clothed with scattered long spiny hairs; the central area of the cephalic and thoracic segments covered with short, dark-brown, slightly curved, rose-shaped thorns which, upon the 1st to 3rd abdominal segments, are in more uniform bands and extend across the segments; 4th to 6th segments with the whole surface covered with these spines, with the chitinous bands covered with very small spines. Anal segment short, coalescing with the anal appendages, truncate at base, both very rugose, the anal segment covered with fine spines springing from little bosses. Anal appendages long, in contact from the base, with the tips bifid.



APIOMORPHA HELMSI Fuller. Text-figs. 24, 24a.

The type specimens were taken from an undetermined species of eucalypt near Perth, W. Australia. I have a fine series in groups of two or three formed upon the flower buds of *Eucalyptus redunca* collected by Mr. J. Stair, near York, W.A.

The male galls are scattered over the surface of the leaves. They are of the usual tubular form with the apex dilated, but have the outer surface ribbed and are usually of a yellow colour.

The female galls are sessile, elongate-oval in form, narrow at the base, with from five to seven ridges or angles extending up to the apex, which is arcuate on the edges, convex in the centre with a little projecting cone round the apical orifice.

Female coccid turbinate. Derm slightly opaque, legs and apical abdominal segments brown, anal appendages black. The whole of the dorsal surface clothed with fine spiny hairs increasing in size and numbers on the terminal abdominal segments. The centre of the cephalic and thoracic segments covered with short dark-brown thorn-shaped spines; 1st and 2nd abdominal segments with the central area covered with similar spines; 3rd and 4th with the spines in a transverse row; 5th and 6th with the spines in contact at base along the apical margin. The anal segment rounded on the sides, fringed with fine hairs, coalescing with the slender anal appendages which are rugose on the outer margins, almost in contact along the inner edges and terminating in a fine point turning outward.

APIOMORPHA WITHERSI, n. sp. Text-figs. 17, 17a.

This is an interesting species which I have received from two localities upon the narrow-leaved ironbark, *Eucalyptus pilligaensis*, first from Mr. G. Withers, Gilgandra, N. S. Wales, and the second lot from Mr. J. Macqueen, Millmerran, Southern Queensland. At first sight the female galls might be taken for a small variety of *Apiomorpha ovicola*, but the apex is generally more depressed and they are usually gregarious, several in a row upon the branchlet.

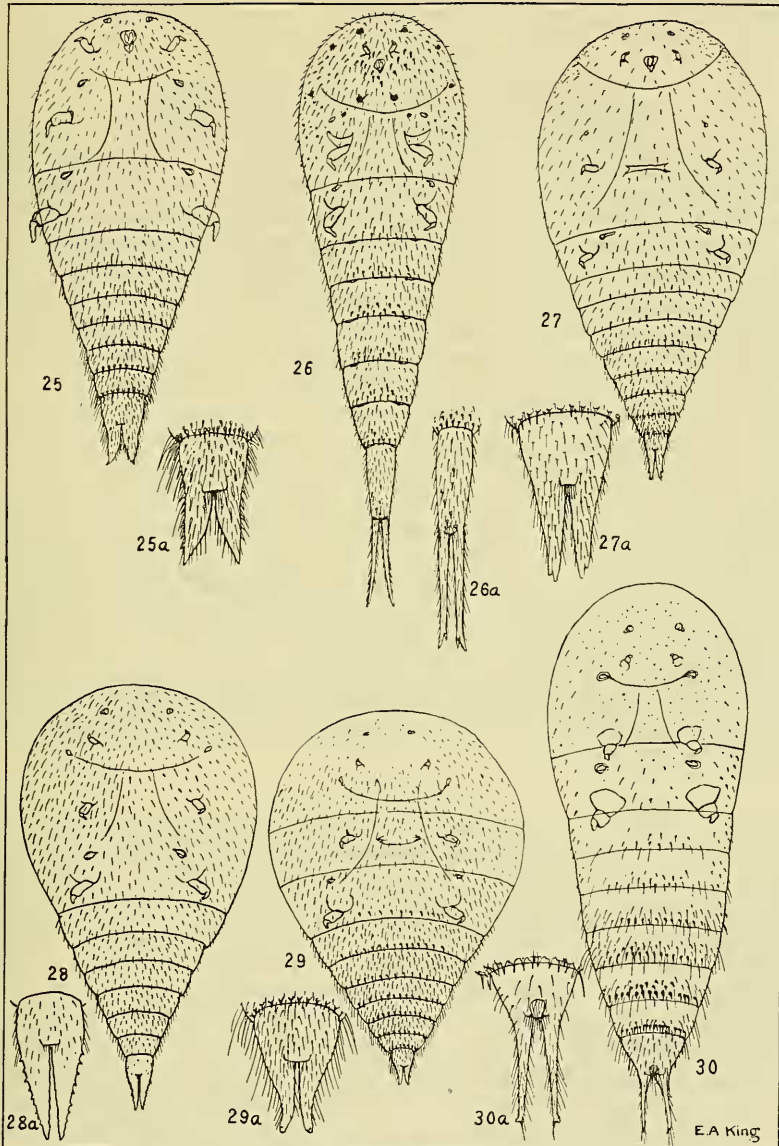
Male gall unknown.

Female coccid light brown, with the external appendages yellowish-brown. The antennae large, broad at base, tapering to the tip, apparently six-jointed; the legs large, the third pair very finely shagreened; thoracic spiracles large, irregularly rounded. The derm lightly clothed with fine hairs on the cephalic and thoracic segments which are more spiny and abundant on the abdominal segments. The 3rd thoracic and 1st and 2nd abdominal segments covered with scattered, dark-brown, small, sharp, thorn-shaped spines, which on the 3rd to 5th abdominal segments form a regular band across the centre, with a cluster of three or four spines in the centre above the regular band; 6th with a band of similar spines along the lower margin. The anal segment long, rounded and rugose on the sides, coalescing with the anal appendages which are slender, finely serrate on the outer margins and separated from each other on the inner margins which are smooth; the tips slightly bifid, turning outward. Anal ring on a chitinous ridge at the base of the anal appendages.

APIOMORPHA FLORALIS Froggatt.

The gall is large, oval and resembles that of *A. ovicola*, but the apex, instead of being rounded, has a distinct raised ring round the apical orifice. The type was growing from a flower bud, *Eucalyptus* sp., and comes from Central Australia.

The general form of the coccid is like that of *A. ovicola*, but the dark thorn-shaped spines down the centre of the cephalic and thoracic segments are much more closely grouped together, forming a continuous, broad, parallel band, not



Text-figs. 25-30.

25.—*Apiomorpha frenchi* Froggatt (25a, anal segment). 26.—*Apiomorpha urnalis* Tepper (26a, anal segment). 27.—*Apiomorpha pharetrata* Schrader (27a, anal segment). 28.—*Apiomorpha fletcheri* Fuller (28a, anal segment). 29.—*Apiomorpha sessilis* Froggatt (29a, anal segment). 30.—*Apiomorpha duplex* Schrader (30a, anal segment).

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extending much beyond the base of the legs; on the abdominal segments the spines are more scattered and numerous. The outer margins of the anal segment and anal appendages with the marginal spines larger, but very irregular, the tips similar and bifid.

I have only had the single type specimen.

Group E.

APIOMORPHA FLETCHERI Fuller. Text-figs. 28, 28a.

This is a very remarkable form of gall structure; the presence of the coccids produces large irregular gouty swellings on the branches. On the surface of these are depressions varying in number from two to five according to the size of the aborted tissue. Over these indentations is a small shred of dead bark, beneath which is the tip of the gall encircling the small circular apical orifice. The real gall consists of this cap which is a thin hard wooden funnel forming a detachable lid fitting over the basal gall chamber containing the coccid. This is simply an oval cavity in the solid mass of aborted wood tissue. The male galls are just as remarkable, masses of tiny pink tubes covering the surface of the leaf. They were described and figured in my paper in *These PROCEEDINGS*, 1930.

It is also interesting to note that they infest gum trees of such distinct species as the red gum with its smooth bark, and the red box growing on the inland rivers. Since my previous paper I have had specimens of this gall from Western Australia.

Female coccid with the cephalic and thoracic segments broad and rounded; the abdominal ones contracted and tapering, rounded on the sides and thickly coated with chitin, the anal one and anal appendages black and rugose. The derm covered with very fine spiny hairs; the abdominal segment thickly covered with fine spiny hairs springing from little bosses, but there are no large distinctive spines like those found on the abdominal segments of all other known species of this genus. The anal segment and anal appendage coalesced form a long lance-shaped tip to the abdomen; the latter finely serrate on the outer edges, with the tips pointed and opening out.

Group F.

APIOMORPHA DIPSACIFORMIS Froggatt. Text-figs. 12, 12a.

The type specimen was figured and described in *These PROCEEDINGS*, 1895; the galls were perfect, with the whole of the outer surface covered with fine filaments, which curled downward just like a diminutive teasel.

Specimens received from Queensland on *Eucalyptus pilligaensis* were much more matured and had lost much of their spiny covering. These were figured in my paper in *These PROCEEDINGS*, 1930, together with the male galls.

Female coccid broad rounded, the apical abdominal segments reddish-brown, banded with chitin. Derm lightly clothed with fine spiny hairs, and annular pores thickest upon the basal half of the abdominal segments; a few small lance-shaped spines on the cephalic fold near the base of the antennae, and irregular bands of larger lance-shaped spines upon the 2nd and 3rd thoracic segments; the 1st and 2nd abdominal segments with similar spines on basal bosses, 3rd to 6th banded with chitinous plates bearing a row of stouter spines with the annular pores showing through the chitin and very fine spines over the apical portion. Anal segment very small and narrow, coalescing with the stout peg-shaped anal appendages, which are broadest at the base, open in the centre, rounded and rugose on the outer

sides, bifid at the tips and fringed with fine hairs. Anal ring chitinous, indistinct. In most species the number of segments in the antennae is difficult to determine, but in this and the following species they are well defined.

APIOMORPHA EXCUPULA Fuller. Text-figs. 9, 9a.

This species is confined to New South Wales; I described the male galls and figured them with the female galls in These PROCEEDINGS, 1930.

Female coccid broadly rounded to the abdominal segments. Length, 13 mm. Derm slightly opaque with the last four abdominal segments banded with chitin, reddish-yellow, the whole surface clothed with fine spiny hairs, and annular pores, the latter thickest on the abdominal segments. A few small lance-shaped spines on the cephalic fold, and irregularly scattered over the last two thoracic segments; 1st to 3rd abdominal segments thickly covered with fine spiny hairs and a band of long slender lance-shaped spines, 4th to 6th fringed with a band of long lance-shaped spines. Anal segment very small, coalescing with the anal appendages, which are broad at the base, curving outward into peg-shaped bifid tips, rugose, open on the inner margins, with a tuft of long hairs on either side. Anal ring at base of anal appendages chitinous and indistinct.

Group G.

APIOMORPHA PEDUNCULATA Fuller. Text-figs. 14, 14a.

This fine species which varies somewhat in both form and size, is recorded upon a number of different species of Eucalypts and has a wide range over southern and eastern Australia.

In the vicinity of Sydney it is found upon *Eucalyptus viminalis* and *E. saligna*; Moira, Murray River, on *E. rostrata*; Lansdown, N. S. Wales, on *E. punctata*, Mr. A. C. McIvor; Gilgandra, *E. amplifolia*, Mr. G. Withers. From Queensland, at Imbil, on *E. punctata*, Mr. A. M. Rankin. From South Australia on *E. leptophylla*, Encounter Bay, Professor J. B. Cleland. From Victoria on an undetermined eucalypt, Mr. C. French, Jr.

Male galls of the typical tubular form with the apex dilated are scattered over the foliage.

The female gall, springing from the branchlet in a slender circular stem, swells out into an elongate-oval gall, truncate at the tip. Sometimes solitary, at other times in clusters of three or four.

Female coccid rounded at base with the segments tapering to the apex, but of uniform width. Length, 25 mm. Derm slightly opaque, last three abdominal segments and anal appendages chitinous, the latter black. The whole surface thickly covered with very fine small slender spines and annular pores. Abdominal segments banded with longer slender spines, with a few short conical spines on the 1st abdominal segment, 2nd and 3rd with an irregular band of conical spines, 4th to 6th with a row of larger conical spines in the centre, not reaching to the outer edges. Anal segment coalescing with the long awl-shaped anal appendages, rounded at the base, outer edges fringed with hairs and slender spines, in contact at the base, opening out into slender irregular lance-shaped tips.

APIOMORPHA LONGMANI Froggatt. Text-fig. 3.

This species is described, and the galls figured in my paper in These PROCEEDINGS, 1930. The type is in the Queensland Museum. The female coccid is about

9 mm. in length. The cephalic and thoracic segments rounded to the abdominal segments, which are contracted and narrow from the second segment. Anal segment rounded at the base, coalescing with the stout lance-tipped anal appendages which are open from the base, curving outward, rugose and spined on the outer margins.

APIOMORPHA FRENCHI Froggatt. Text-figs. 25, 25a.

This species was described in my Descriptive Catalogue (*Science Bulletin* 18, Department of Agriculture, N. S. Wales, 1921). The type specimens were collected by Mr. C. French, Jr., on the branchlets of a red gum, *Eucalyptus rostrata*, growing on the banks of the Werribee River, Victoria. I have since had a large series in all stages of development from the same locality.

The male galls are very numerous on the leaves and branchlets among the female galls. They are of the typical cylindrical form, but rather short, with the apex broadly dilated.

The female galls single or clustered together in groups on the branchlets, sessile, cylindrical, with the apex truncate, centre slightly convex, with the apical orifice small. The immature galls are green, but as they mature they change to brown, and in old specimens crack into fine rings on the surface.

Female coccid 11 mm. in length; abdominal segments contracted, reddish-brown, banded with chitin, anal segment and anal appendages black. Derm lightly clothed with very small short spiny hairs, forming bands across the first two abdominal segments; 3rd with an irregular band of lance-shaped spines in the centre, 4th to 6th with a regular band of larger lance-shaped spines. Anal segment rounded at base, coalescing with the anal appendages, which are broad at the base, opening out and rounded, forming broad lance-shaped tips.

APIOMORPHA CONICA Froggatt. Text-fig. 19.

This somewhat variable gall has a wide range over eastern and southern Australia, but I have not seen specimens from Queensland. In the vicinity of Sydney it is found upon *Eucalyptus robusta*, *E. viminalis* and *E. Deanei*; from Guyra, N. S. Wales, on *E. Nicholi*, Rev. E. N. McKie; Glen Innes in the north and Captain's Flat in the south on undetermined eucalypts. From Victoria upon *E. Gunni*, Hamilton, and *E. regnans*, Croydon, Mr. C. French, Jr. It was described from South Australia by Mr. J. G. O. Tepper. In the herbarium of the Sydney Botanic Gardens there are specimens from Broken Hill on *E. dumosa*, Mr. A. Morris; Cobar, *E. dumosa*, Mr. J. C. Boardman; East Mirool, *E. oleosa*, Mr. Campbell; Bellerive, W. Australia, *E. viminalis*, Mr. J. H. Maiden; Kaneara, Victoria, *E. bicolor*, Rev. W. W. Watts.

Male galls of typical form, tubular with dilated apex, scattered about over the surface of the leaves.

Female galls broadly oval, with the conical apex distinctly ringed round the apical orifice, grouped in bunches or single on the branchlets. A plate is given in my Descriptive Catalogue, 1921, showing the variation in form of this gall.

Female coccid with the derm clothed with fine spiny hairs increasing in size and numbers to the abdominal segments. Length, 20 mm. Annular pores present, thickest on the abdominal segments; the 3rd thoracic and 1st abdominal segments covered with stiff spiny hairs, 2nd to 6th abdominal segments banded with chitin, dull yellow, clothed with fine slender spines and banded with stout lance-shaped

spines, in the last three forming a close row along the lower margin. Anal segment merged into the anal appendages, rounded at the base, short and broad, terminating in two broad pointed fingers opening outward.

APIOMORPHA ATTENUATA Froggatt. Text-fig. 21.

This species was described from a gall from a spray of slender fusiform galls produced on the flower-buds of an undetermined species of *Eucalyptus* which came from South Australia, without any definite locality. There is a drawing of this spray of galls in my original description in These PROCEEDINGS, 1898, and a photograph in my Descriptive Catalogue (Department of Agriculture, N. S. Wales, *Science Bulletin* 18).

Female coccid with the cephalic and first two thoracic segments rounded, contracted on the upper margin of the third thoracic segment which, with the first abdominal segment, is broad and of uniform width, the 5th and 6th abdominal segments reddish-brown, chitinous, anal segment and anal appendages dark reddish-brown. Length of female coccid, 9 mm.

Derm clothed with fine spiny hairs, 1st to 3rd abdominal segments with a few scattered small lance-shaped spines across the centre interspersed with long spiny hairs, 4th to 6th with the lower margin fringed with a row of stout lance-shaped spines. Anal segment merged into the anal appendages which are broad and rounded at the base, divided and curving outward into lance-shaped tips, fringed on the sides with fine hairs.

Considering the slender form of the gall, one would expect to find the enclosed coccid of the slender type with attenuated abdomen, instead of this rather stout coccid with thickened anal appendages.

Group H.

APIOMORPHA GLOBOSA Froggatt. Text-figs. 10, 10a.

The type specimens were collected on the branchlets of the red gum, *Eucalyptus rostrata*, near Hay, N. S. Wales. I have lately received a fine series from Gilgandra, N.S.W., on *E. dealbata*, from Mr. G. Withers. The female galls dull brown when mature, sessile and usually solitary, rounded and slightly concave on the summit.

Female coccid pale-yellow, semi-opaque, in old specimens the abdominal segments reddish-yellow and the anal appendages black; broadly turbinate. Length, 10 mm. Derm clothed with rather long spiny hairs thickest on the sides of the cephalic and thoracic segments, 1st and 2nd thoracic segments with an irregular line of very small lance-shaped spines across the centre; 1st to 6th abdominal segments with a scanty line of small lance-shaped spines across the centre of the segments. These spines, opening out at the base, might be likened to arrow heads, particularly on the 4th and 5th segments. Anal segment and anal appendages coalesced, fitting close against the 6th segment, truncate and combined, forming an elongated triangle, with the anal ring with a chitinous ridge in the centre. The anal appendages in contact along the inner edges, slender, rugose, the outer edges serrate, with the tips pointed and turning outward.

APIOMORPHA MALIFORMIS Fuller. Text-figs. 18, 18a.

This species comes from south-western Australia, where it infests the blackbutt, *Eucalyptus patens*. I have had a fine series of galls from Messrs. Wallace and Stewart from Busselton, and Mr. Kessell from Jarradale and Margaret River,

chiefly upon branchlets, but in one case the galls were half embedded in the bark of a stout sapling gum. Mr. L. J. Newman sent me specimens from near Perth on *E. Toddiana*.

Fuller when describing this species said that the galls were usually found upon the flower-buds of the eucalyptus, but this, I think, is a slip, confounding them with the smaller *Apiomorpha helmsi*, described in the same paper, which is also plentiful in the same localities.

The male galls are small slender tubes, slightly dilated at the apex, which are produced on the surface of the leaves.

The female galls are solid woody masses, apple-shaped, broadly rounded and depressed in the centre at the apex, with the apical orifice in the centre. They are light brown in colour, slightly roughened, and often massed together in groups of three or four; up to $1\frac{1}{2}$ inches in diameter and $1\frac{1}{4}$ inches in height.

Female coccid broadly turbinate, abdomen coming to a point, terminal ones chitinous. Length, 15 mm. Derm clothed with fine spiny hairs, thickest on the abdominal segments, which show annular pores scattered among them; 3rd thoracic and 1st abdominal segments with irregular band of lance-shaped spines, 2nd to 6th with a more regular band of thorn-shaped spines. Anal segment very small, coalesced with anal appendages, rounded on the sides, rugose; anal appendages rugose, in contact on the inner edges, fringed with fine hairs, bifid at tips. Anal ring fringed with fine hairs.

APIOMORPHA STROMBYLOSA Tepper. Text-figs. 15, 15a.

This distinctive gall has a wide range over eastern and southern Australia, and infests many different species of eucalypt. In the vicinity of Sydney it is found on *Eucalyptus siderophloia*, the broad-leaved ironbark. The type was described from South Australia on *E. incrassata*; I found it at Euston, N. S. Wales, upon a mallee gum, *E. transcontinentalis*; Ourimbah, N. S. Wales, on *E. punctata*, Mr. de Beuzeville; Imbil, Queensland, on *E. paniculata*, Mr. M. Rankin; W. Australia, *E. sp.*, Mr. C. Fuller; Victoria, *E. polyanthema*, Mr. C. French, Jr. The female galls are shaped and have a rough brown surface like a sheoak seed-cone, and on account of their dark colour and size are very noticeable among the foliage. They are sometimes solitary on the stem or branch, or in clusters of three or four. The male galls are irregularly rounded, slender, without the apex dilated, dark reddish-brown; thickly scattered over the surface of the leaves.

Female coccid broadly turbinate, terminal abdominal segments small and barred with chitin. Length, 21 mm. Derm clothed with very long spiny hairs and annular pores, the former forming regular bands across the thoracic segments, the latter very small and most numerous on the thoracic and abdominal segments; 1st abdominal segment with only one or two lance-shaped spines, 2nd with an irregular band of rather long lance-shaped spines, 3rd to 5th with a regular row of similar spines; 6th with fewer spines across the centre. Anal segment truncate at base, sloping in on either side and coalescing with the anal appendage, both rugose, covered with spiny hairs springing from rounded bosses. Anal appendages lance-shaped, open along inner margin, rugose and fringed with fine hairs, bifid at the tips, anal ring indistinct.

APIOMORPHA VARIABILIS Froggatt. Text-figs. 16, 16a.

This species is restricted in its range from Sydney to southern Queensland. In the Sydney district it is found upon *Eucalyptus saligna*, *E. Sieberiana*, *E. piperita*.

E. Camfieldi and *E. umbra*. At Gosford, N.S.W., on *E. pilularis*, Mr. A. Murphy; Port Macquarie, *E. sp.*, Forester Brown. From Queensland, Imbil, on *E. acmenioides*, Mr. M. Rankin.

This female gall is sessile and consists of two parts. The basal portion consists of a solid woody mass, covered with a smooth green skin which contracts about two-thirds from the base, and rises like a rounded dome over the basal gall. It has a ragged opening on the summit, above the irregular cavity, between it and the apical orifice into the gall chamber. Though this is not an uncommon species, I have seen no male galls.

Female coccid broadly turbinate, 13 mm. in length. Pale yellow with the abdominal segments darkest. Derm clothed with scattered hairs and annular pores. The 3rd thoracic segment thickly covered with long spiny hairs interspersed with fine short spines; 1st to 3rd abdominal segments covered with similar spiny hairs and small lance-shaped spines; 4th to 6th with large spines forming a regular band across the lower margin of the segments. Anal segment coalescing with the anal appendages and combined forming an elongate triangle, slightly rounded at the base, covered with fine spines, slightly rugose on the outer margins and fringed with fine hairs; the anal appendages slender, almost in contact along the inner margins, and the tips bifid, the outer point largest and turning outward.

APIOMORPHA BÄUERLENI Froggatt. Text-figs. 23, 23a.

The type specimens were collected at Ballina, N.S.W., upon an undetermined species of *Eucalyptus*. I have never seen any more specimens. Male gall unknown.

Female galls are sessile, single or in groups of two or three upon the branchlets. They are rounded, slightly ribbed on the sides, and depressed on the apex; the walls are double round the coccid chamber, the outer one soft, over a hard woody sheath round the enclosed coccid. This often produces a ragged edge round the apical orifice.

Female coccid broadly turbinate, much wrinkled, with the abdominal segments coming to a fine point, 12 mm. in length. Derm slightly chitinous, anal segments yellow, very lightly clothed with short spiny hairs; 2nd and 3rd thoracic segments bearing a few small blunt spines; 1st and 2nd abdominal segments with irregular bands of longer sharp lance-shaped spines; 3rd to 6th with the spines increasing in size and forming regular rows across the lower margins. Anal segment coalescing with the anal appendages, tapering to a slender point, serrate along the outer margins, in contact on the inner margins and slightly bifid at the tips. Anal ring showing on a chitinous ridge at the base of the anal appendages.

Group I.

APIOMORPHA MUNITA Schrader. Text-figs. 22, 22a.

This is the most variable form of gall, and one of the widely distributed species of the genus. The original specimens described by Schrader were collected near Sydney.

I have specimens upon *Eucalyptus saligna*, *E. piperita*, *E. siderophloia* and *E. paniculata* from the vicinity of Sydney; from Gilgandra, N.S.W., on *E. crebra* and *E. sideroxyton*, Mr. G. Withers; *E. leptophylla*, Euston, N.S.W., W.W.F.; from Victoria on several undetermined species of eucalypt; from Western Australia, *E. sp.*, Mr. L. J. Newman; from Cairns, N. Queensland, Mr. E. Jarvis.

In the Herbarium of the Botanic Gardens, Sydney, there are specimens from Lockhart, N.S.W., on *E. melliodora*. Merool, on *E. oleosa*, Urunga, on *E. grandis*, Pine Creek, on *E. fructorum*; Murray Bridge, S. Australia, on *E. incrassata*.

Male galls irregular, slender, rounded tubes, massed together in great numbers upon the branches and often formed upon the horns and sides of the adjacent female galls.

The typical female gall springs from the branch with a rounded base with the apical margin angulated, and each corner produced into a long projecting slender horn. The variations in both the male and female galls are illustrated on plates 132 and 134 in my Descriptive Catalogue.

Female coccid turbinate, abdominal segments chitinous, small. Length, 20 mm. Derm clothed with a few spiny hairs and many very small lance-shaped spines of different sizes, forming with the spiny hairs irregular bands across the thoracic and abdominal segments; 4th to 6th abdominal segments closely covered with rounded chitinous bosses from which small spines spring. Anal segment short and broad, rounded on the sides, coalesced with the anal appendages which are short, broad at the base, tapering to the tips which turn outward and are bifid. The whole rugose and fringed with fine hairs.

APIOMORPHA HILLI Froggatt.

This curious gall was described and figured in my Descriptive Catalogue, Pt. ii (Department of Agriculture, N.S.W., *Science Bull.* 18, 1921). It is found on the woollybutt, *Eucalyptus miniata*, in the vicinity of Darwin, North Australia.

The remarkable likeness of the female gall to the seed capsule of its host tree is shown in the plate in my Catalogue. Somewhat like the gall of *Apiomorpha variabilis*, the basal portion is solid wood enclosing the gall chamber; above this is a cavity surrounded by an outer rim to which coalesces a pointed wooden cap, which cracks off but remains attached on one side as the gall matures.

Adult coccid about half an inch in length, very broad, rounded, and wrinkled, the anal segments very small. Abdominal segments banded with long lance-shaped spines; anal segment coalescing with the short anal appendages, rounded at the base, broad and tapering to the tips which turn outward. Fringed with fine hairs.

APIOMORPHA SESSILIS Froggatt. Text-figs. 29, 29a.

This is a rare species; the type specimens were collected at Newcastle, N.S.W., on an undetermined species of *Eucalyptus*. Several other specimens were collected near Hornsby on *Eucalyptus deformis* by Messrs. Shiress and Blakely, and a single specimen by Miss T. M. Irby at Casino, N.S.W.

Male gall unknown.

Female gall cylindrical, the base buried in a swelling in the stem; the summit truncate, rugose, and the apical orifice in the centre.

Female coccid broadly turbinate, yellow, apical segments chitinous. Length, 10 mm.

Derm clothed with fine spiny hairs springing from small rounded bosses, thickest on the lower thoracic and abdominal segments; 3rd thoracic segment with a few stout conical spines scattered across the centre; 1st to 2nd abdominal segments with a scattered row of small conical spines across the centre, 3rd to

6th with a very close row of similar larger spines, on the 6th along the lower edge. Anal segment short, rounded at the sides, coalescing with the short anal appendages, which are broad at the base, tapering to the pointed tips which turn outward, slightly serrate and fringed with fine hairs. Anal ring obscure, at the base of the anal appendage.

APIOMORPHA MINOR Froggatt. Text-figs. 8, 8a.

The type specimens were collected at Wollongong, N.S.W., upon *Eucalyptus haemastoma*. It has been recorded upon the same eucalypt by Mr. D. Shiress, near Sydney; *E. eugenoides*, Hornsby, Mr. Blakely; *E. capitellata*, Neutral Bay, Professor J. B. Cleland; *E. sp.*, Guyra, Rev. E. N. McKie. From Victoria, Mr. C. French, Jr., collected it on *E. polyanthema* at Warrandyte.

Male galls upon the foliage rather small, of the typical tubular form, with the apex dilated.

Female galls sessile, oval, broadest at the base, truncate at the apex with the apical orifice in the centre of the concave depression. Generally in clusters of three or four on the branchlets.

Female coccid turbinate, with the abdominal segments small. Length, 12 mm. Derm thickened, yellow, last four abdominal segments banded with chitin; the whole surface covered with short slender spiny hairs springing from circular bosses; a few short spines on the second thoracic segment, with an irregular band across the third thoracic segment; 1st to 3rd abdominal segments with a row of thorn-shaped spines forming a band across the centre; 4th to 6th with the spines forming a closer band across the lower half of the segments. Anal segment coalescing with the anal appendages, rounded at base and sides, rugose, the anal appendages short, broad at the base, tapering to pointed tips which curve outward and are fringed with fine hairs. Anal ring surrounded by a chitinous ridge at the base of the anal appendages.

APIOMORPHA DUMOSA Froggatt. Text-figs. 7, 7a.

This species was described and the galls figured in my paper in These PROCEEDINGS, 1930. It is found in the Mallee scrub and the oval sessile gall has nothing very characteristic about it. The enclosed coccid, however, has distinct specific characters and falls into this group. The derm is chitinous with no large spines on the thoracic segments, with the 2nd to 6th abdominal segments thickly clothed with very fine spines and rows of lance-shaped spines across the apical half of each. Anal segment very small, with the anal appendages small, rounded at the base, tips small, bifid, and curving outward.

APIOMORPHA RUGOSA Froggatt.

This species was described from a number of galls collected upon an undetermined species of eucalypt growing at Ellalong, near Maitland, N.S.W.

The galls are sessile, with the rounded surface furrowed and rugose, the apex slightly depressed, with a circular pit above the apical orifice. The coccid irregularly turbinate, wrinkled, with the abdominal segments small and coming to a fine point, the abdominal segments fringed with fine spines, and the anal appendages and anal segment small, fringed with fine hairs, the former short, broad at base, with the tips tapering to the tips which open out, the sides rugose.

APIOMORPHA ANNULATA Froggatt. Text-figs. 5, 5a.

This species was described in my paper in These PROCEEDINGS, 1930, with the galls figured. It comes from Queensland.

The galls and coccid fit into this group. The coccid has the typical distribution of spiny hairs and spines on the dorsal surface, of which *Apiomorpha munita* might be taken as the typical form. The abdominal segments are small, and agree in general form, but the anal appendages are not quite typical as they are not so broad at the base, are more lance-shaped, and do not curve outward so much at the tips. They, however, come nearer this than any other group.

The type is in the Queensland Museum.
